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above described ones. Constituent elements that are fundamentally the same as those shown in FIG. 6 are denoted with the same reference numerals.

FIG. 20 is a block diagram explaining a configuration of a transmitting device according to a fifth preferred embodiment. The transmitting device is that implemented when a diversity transmission technique is applied.

In the fifth preferred embodiment shown in FIG. 20, the transmitting device comprises 2 two-dimensional spreading units 603, 2 transmitting units 604, and 2 antennas 606. To each of the two-dimensional spreading units 603, data (symbol) is output from a diversity processing unit 2001 prepared, for example, for each channel. A spread code generating unit 602 outputs the same spread code to each of the two-dimensional spreading units 603 for the same data.

Each of the diversity processing units 2001, to which data is input from the multiplexing unit 601 shown in FIG. 6, converts the data into mutually orthogonal sequences, and outputs the data after being converted to each of the two-dimensional spreading units 603. Then, after each of the two-dimensional spreading units 603 spreads the same data (channel) with the same spread code, it outputs the data to each of the transmitting units 604. As a result, the same signals are transmitted from the separate antennas 606.

FIG. 21 is a block diagram explaining a configuration of a transmitting device according to a sixth preferred embodiment. The transmitting device is applied the diversity transmission technique by another method.

In the sixth preferred embodiment shown in FIG. 21, to each of two-dimensional spreading units 603, the same data is input from the multiplexing unit 601 shown in FIG. 6. Accordingly, a spread code generating unit 601 outputs mutually orthogonal spread codes for the same data to each of the two-dimensional spreading units 603. Such spread codes are output to each of the two-dimensional spreading units 603, thereby eliminating the need for providing the diversity processing units 2001 shown in FIG. 20.

In the configuration shown in FIG. 21, if a pilot channel (symbol) is shared by a plurality of users, a spread code that is orthogonal to other spread codes not only as an entire two-dimensional code but also as its extracted portion, namely, spread codes that satisfy all of the above described conditions 1-3 must be generated by the number of antennas 606 or more. By example, if a spread code of SF4×4 is considered, a maximum of 4 spread codes, which are orthogonal even if they are despread with any of spreading factors SF4×1, SF4×2, SF2×2, and SFN×4 (N=1,2,4), can be allocated at the same time as shown in FIGS. 22A-22C. A code domain is further enlarged or the number of spreading factors with which despreading can be made is further reduced, whereby the number of such spread codes can be further increased. A-D denoted in FIGS. 22A-22C indicate the code domains of the 4 allocatable spread codes.

FIG. 23 is a block diagram explaining a configuration of a transmitting device according to a seventh preferred embodiment. This transmitting device is that implemented when an MIMO (Multiple Input and Multiple Output) technique is applied.

In the seventh preferred embodiment shown in FIG. 23, a multiplexing unit 601 splits data (symbol) into a plurality of sequences, and outputs the sequences to each of two-dimensional spreading units 603. Accordingly, if a pilot channel (symbol) is shared by a plurality of users in the same manner as in the sixth preferred embodiment, spread codes that are orthogonal to other spread codes not only as an entire two-dimensional spread code but also as its extracted portion,

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namely, spread codes that satisfy all of the above described conditions 1-3 must be generated by the number of antennas 606 or more.

Here, the other preferred embodiments implemented when the diversity transmission technique and the MIMO technique are applied are described as the fifth to the seventh preferred embodiments. However, a variety of other techniques can be applied.

What is claimed is:

1. A spread code allocating method executed by a transmitting device for allocating to each channel a two-dimensional spread code used for making a spread in time and frequency directions, comprising:

selecting spread codes in which at least one of the time and the frequency directions are mutually orthogonal, and which enable despreading with spreading factors that are smaller than spreading factors applied to spreading of each channel in both of the directions; and determining a spread code to be allocated to each channel from among the spread codes.

2. The spread code allocating method executed by the transmitting device according to claim 1, wherein the allocation of spread codes to each channel is made by targeting a predetermined channel selected as a selection target.

3. A despreading method executed by a receiving device that receives a symbol of a channel for despreading the symbol, the symbol being spread with a spread code allocated with the spread code allocating method according to claim 1 and being transmitted, comprising:

despreading received symbols of a same channel with a plurality of spread codes including spread codes that at least one of spreading factors of the time and the frequency directions is smaller than a spreading factor applied to spreading of the same channel; and determining spread codes used to despread a symbol of a channel different from the same channel from results of despreading made respectively.

4. The despreading method executed by the receiving device according to claim 3, wherein the same channel is a channel to which a pilot symbol is transmitted.

5. The despreading method executed by the receiving device according to claim 4, wherein the determined spread code is changed depending on a need based on the pilot symbol received after determination.

6. The despreading method executed by the receiving device according to claim 3, wherein the determined spread codes are changed based on a result of despreading the symbol of the different channel with the spread codes.

7. The despreading method executed by the receiving device according to claim 3, wherein a moving velocity of the receiving device for a transmitting device that transmits the symbol of the channel is identified, and the determined spread codes are changed depending on a need based on a result of identification.

8. The despreading method executed by the receiving device according to claim 3, wherein the determined spread codes are changed depending on a need based on a delay spread detected by the different channel.